Synapse
Energy Economics, Inc.

Meeting CT's OTC Commitment
Energy Efficiency and Emissions Controls

Chris James and Jeremy Fisher
Synapse Energy Economics
May 28, 2008

Order of Presentation

- Punch line
- Background / Introduction
- History
- Methodology
- Results
- Recommendations

Punch Line

- Connecticut's energy efficiency program can provide a substantial amount, but not all, of the NOx reductions needed to meet the OTC MOU commitment
- Additional reductions will be needed to assure the commitment is reached and maintained
- Meeting 2009 targets is very difficult
- 2012 will require very aggressive EE plus SCR level of controls (min 50%)
- Sustained EE required to assure long-term compliance with ozone NAAQS

Introduction: A Long and Tortuous Path

- Mid 1990s: NOx program designed pre-restructuring
- Focus: larger EGU- apply controls directly
- Smaller units- emergency only
- Pre-ISO and hourly electric markets

A Certain Box Was Opened

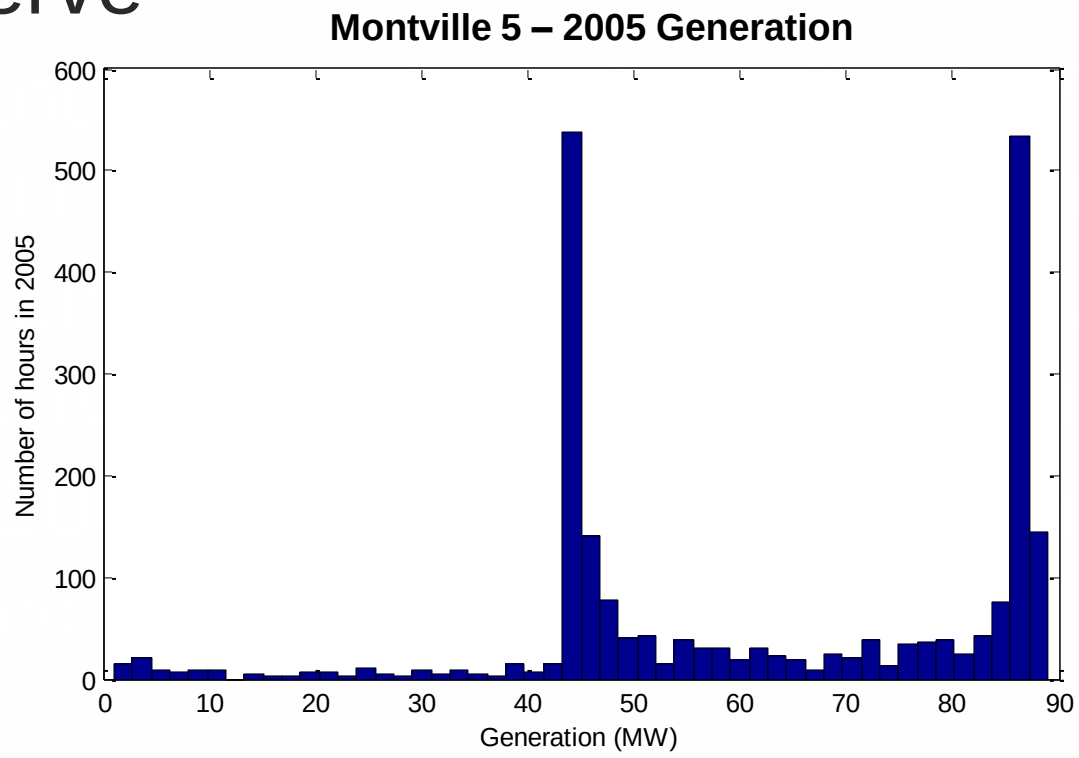
- Restructuring in 1998
- ISO-NE established in 1997, began operations in 1999
- Reliability programs started in 2000 (demand and price response)
- SW CT congestion: 2001--?

Restructuring Created New Paradigm

- New opportunities for smaller units to participate
- Lack of quick start resources = Reliability Must Run units (RMR)
- Supply side focus
- 1/3 of CT energy efficiency $ unavailable 2004-2008
- Increased fuel prices
- Natural gas units set the hourly market clearing price

The Present Story

- Out of merit units operate in spinning reserve



NE-ISO record of RMR ops (2004-2006)

Aggregate Results and Findings

- Totals for 9 Connecticut units at 5 power stations, for the study period; flagging (hours) and associated energy (MWh) for:
  - **Second Contingency:**
    - **27,215 Hrs ~ 11.51% of the total study period**
    - **~49.87% of time online**
    - **2,197,161 MWHr ~ 36.19% of total energy production**
  - Voltage:
    - 5,006 Hrs ~ 2.12% of the total study period // ~ 9.17% of time online
    - 551,058 MWHr ~ 9.08% of total energy production
  - Must-Run:
    - 7,396 Hrs ~ 3.13% of the total study period // ~ 13.55% of time online
    - 1,143,533 MWHr ~ 18.84% of total energy production
  - Total Energy Production:
    - 6,070,849 MWHr
  - Hours Online:
    - 54,571 Hrs ~ 23.07% of the total study period for all units

The Present Story

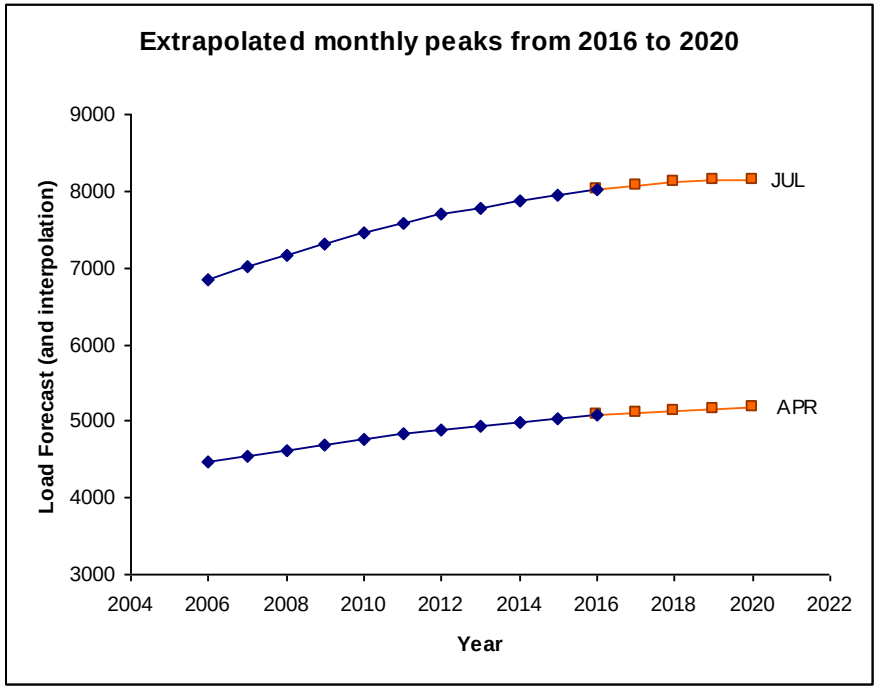
- Out of merit units operate in spinning reserve
- Unknown number of small EGU/engines running at non-emergency conditions
- 8-hour ozone and fine PM standard require further emissions reductions
- CT 2007 OTC MOU commitment
  - Reduce HEDD NO_x by 11.7 T/day

Synapse Tasks

- Evaluate Connecticut's generating mix
- Grow electric demand to 2020
- Assess the amount of EE plus controls needed to satisfy CT's OTC commitment

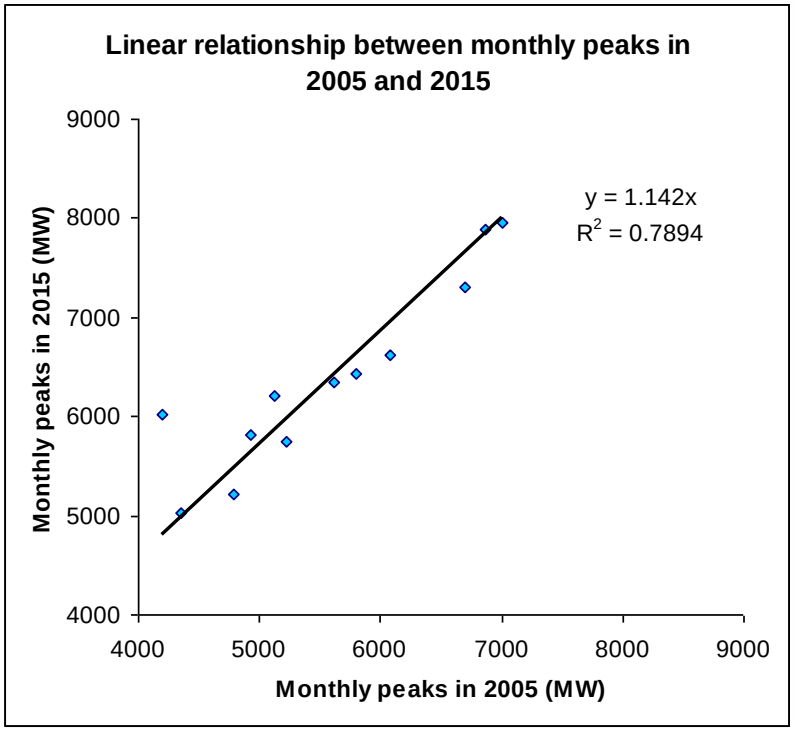
CT Demand Growth

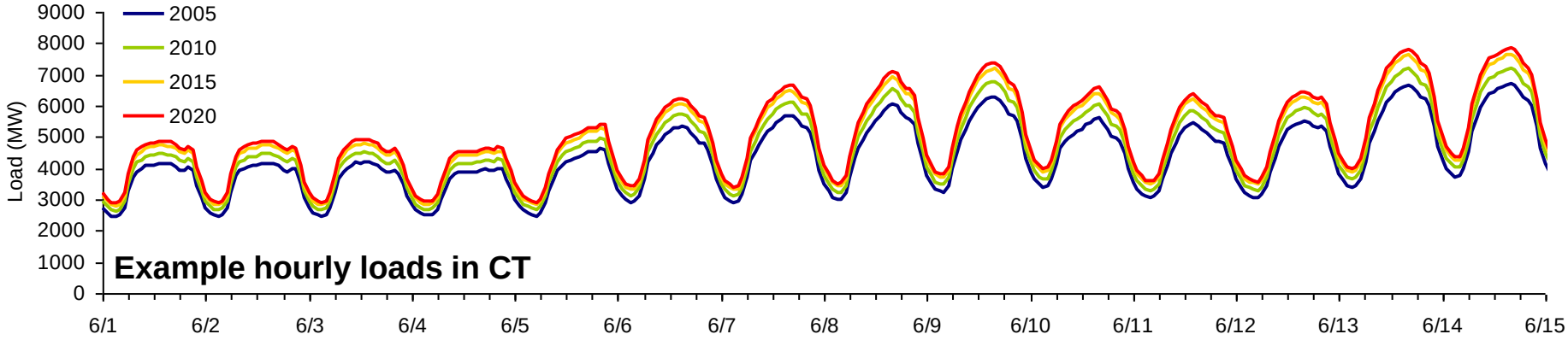
- NE-ISO 2007 monthly peak load forecast based (2008-2016)
  - A) Extrapolate monthly peak curve through 2020



CT Demand Growth

b) Determine linear relationship of peaks in future year against 2005; relationship determines hourly loads





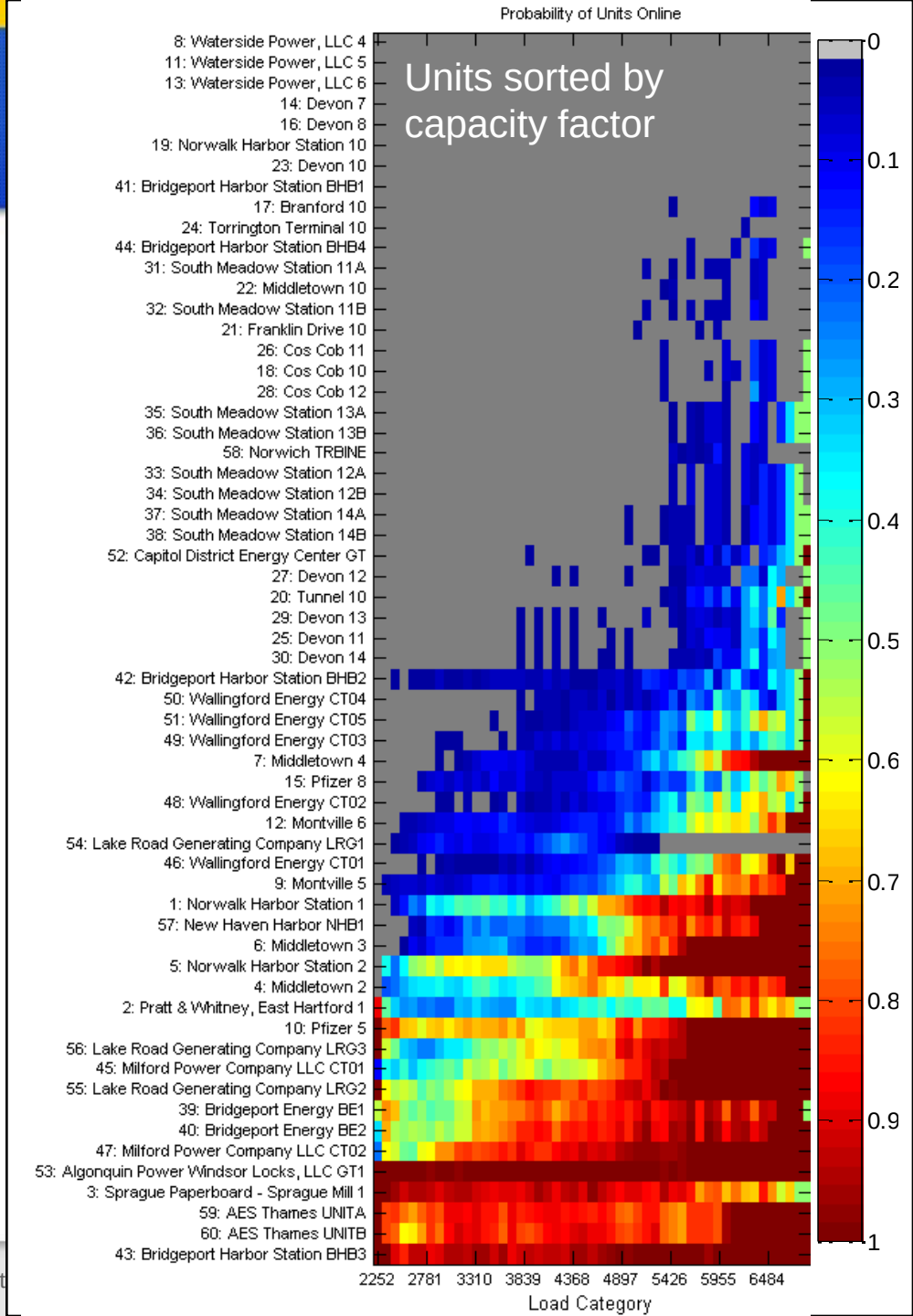
Statistical Emissions Model

- Statistical model built from EPA CAM (Clean Air Markets) hourly dataset and 2005 NE-ISO load
- 8760 hours
- 60 generators represented in CT
  - Generation (MW)
  - NOX (Lbs)
  - SOx (Lbs)

- Basis:
  a) For a given load, a certain cohort of generators will be dispatched
  b) Dispatched units have a range of possible generations for a given load
  c) Units have a range of possible emissions for a given generation
- Monte Carlo method estimates generation and emissions for each load

a) For a given load, a certain cohort of generators will be dispatched

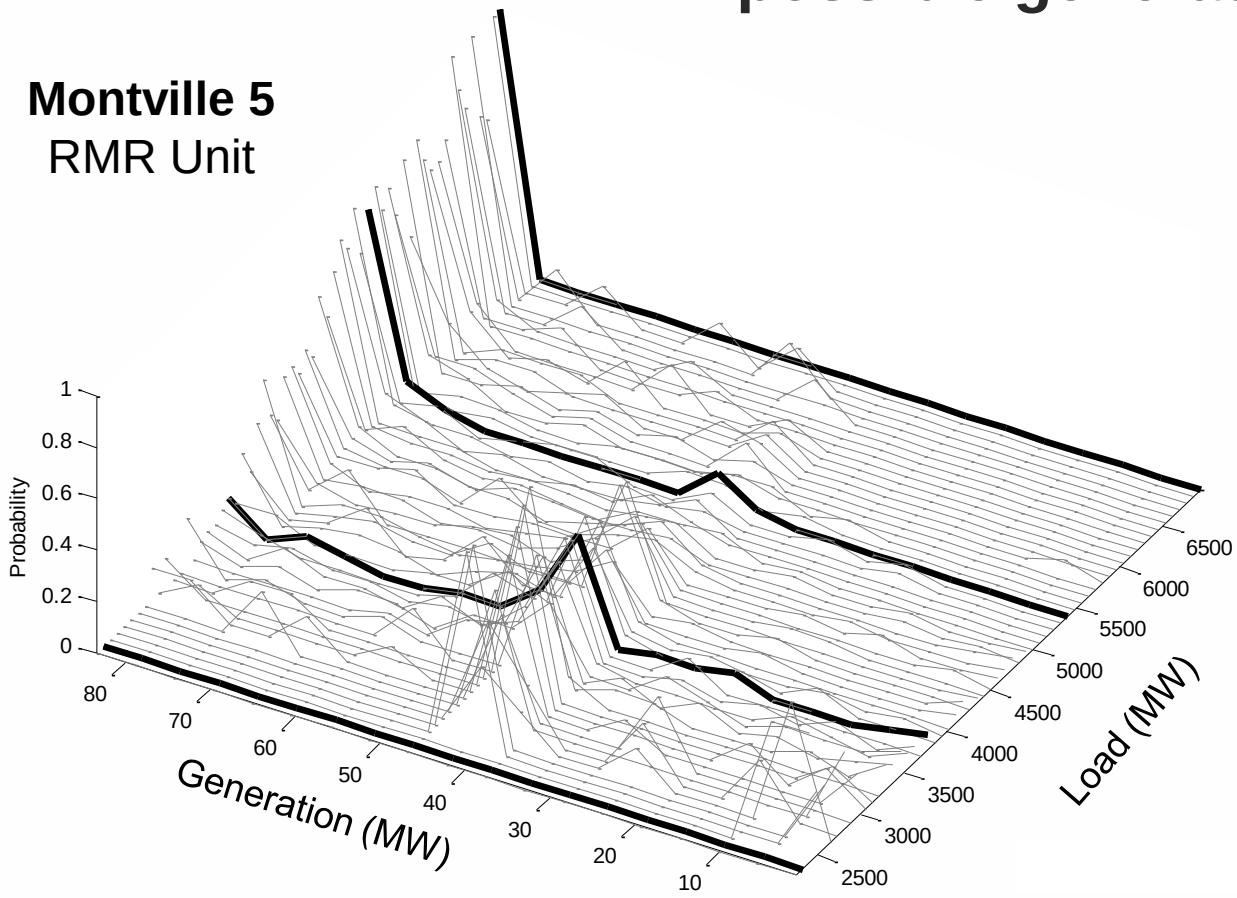
- How likely is it that any given generator will operate at a given load?



Statistical Emissions Model

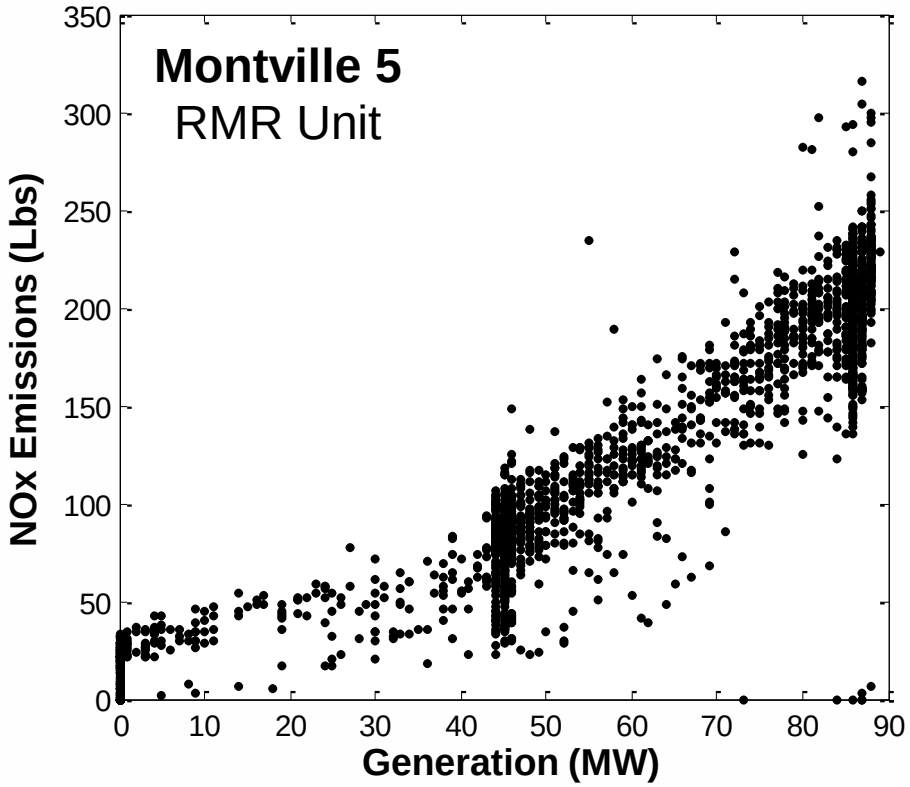
b) Dispatched units have a range of possible generations for a given load

Montville 5
RMR Unit

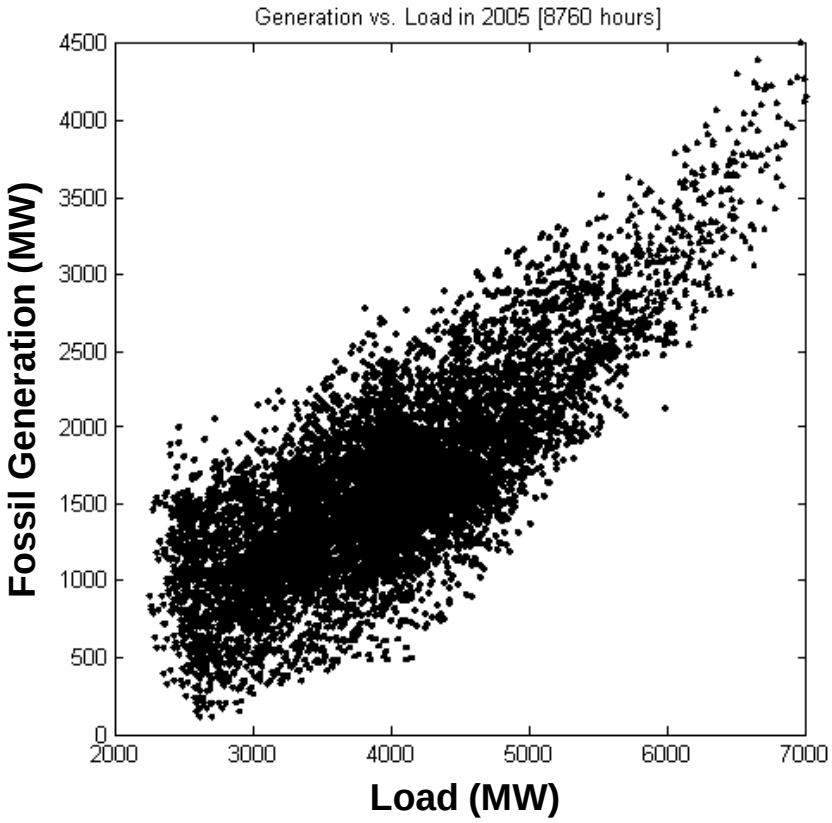


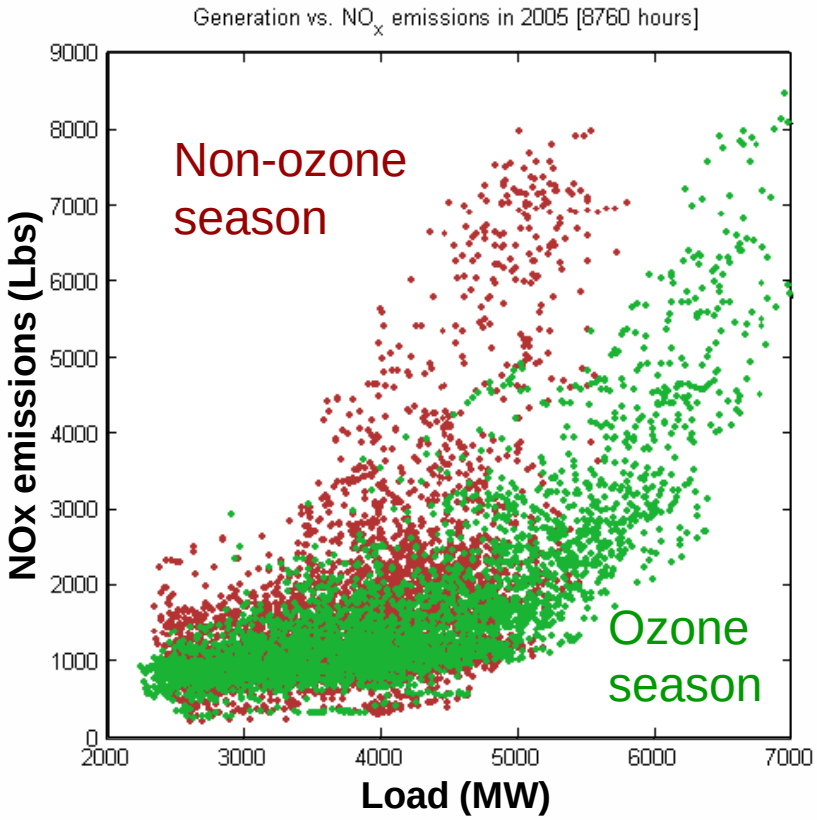
Statistical Emissions Model

c) Units have a range of possible emissions for a given generation



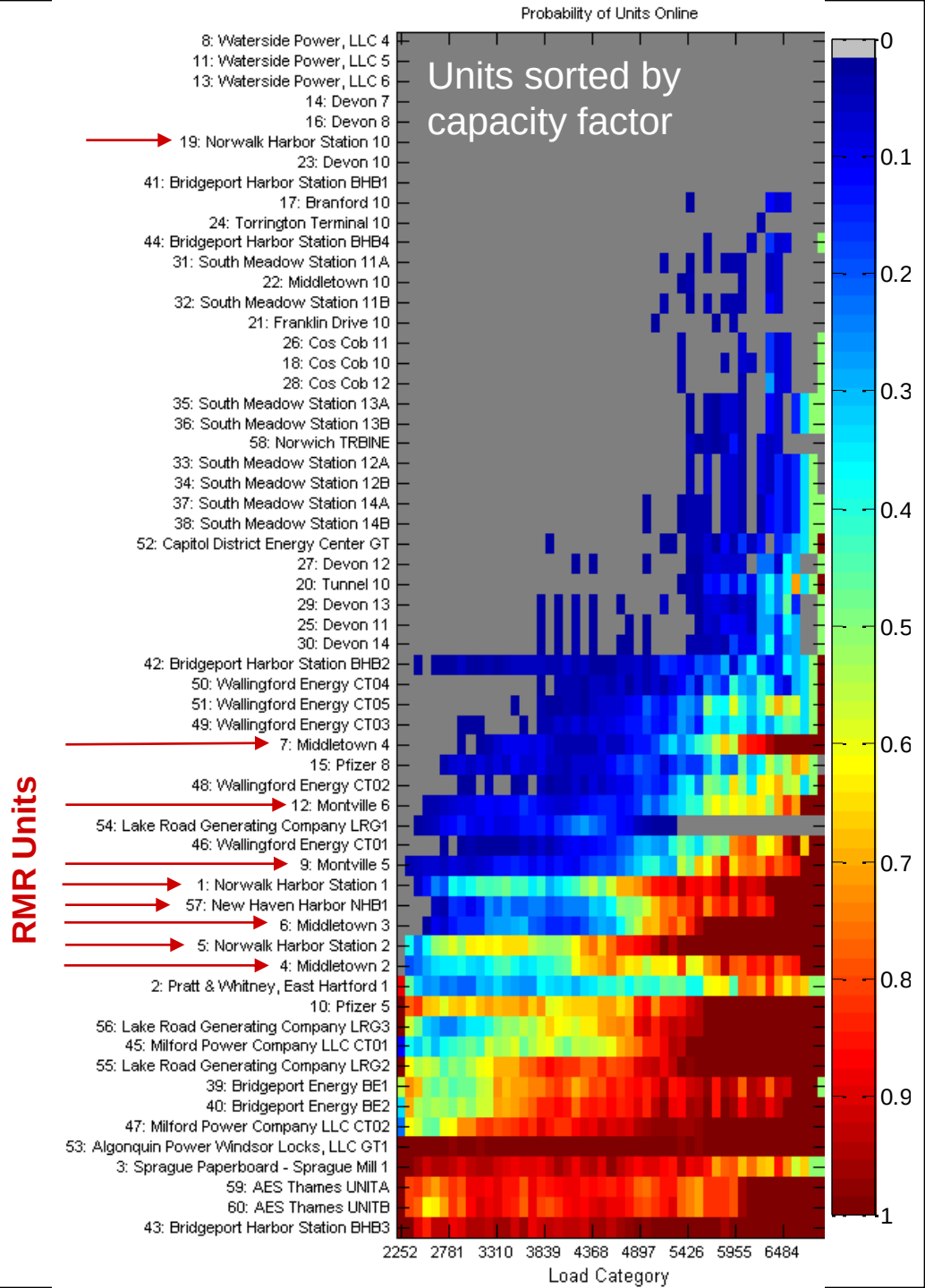
Data characteristics



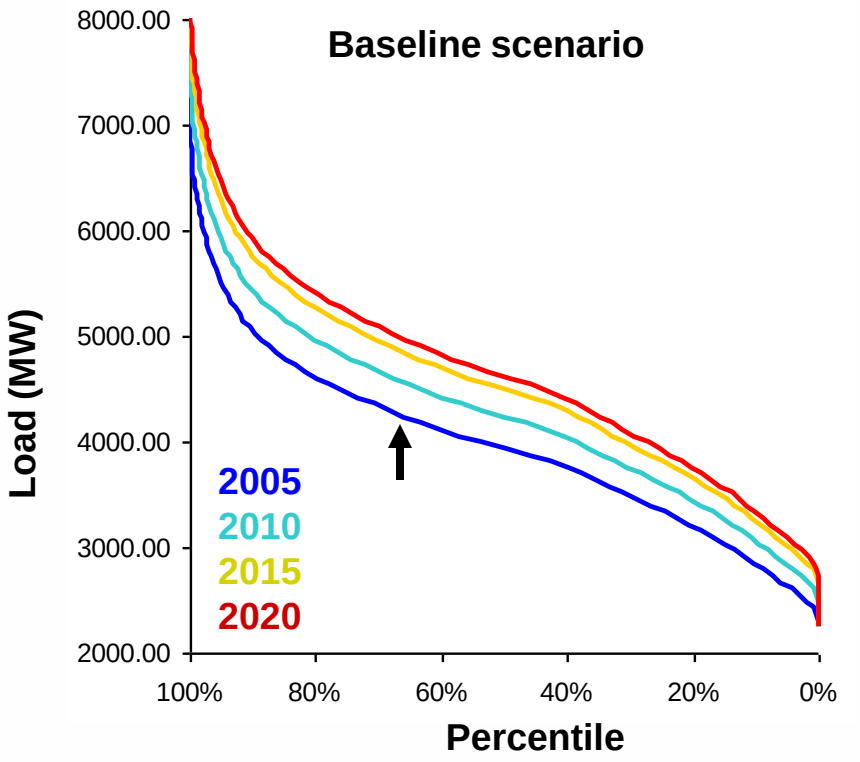


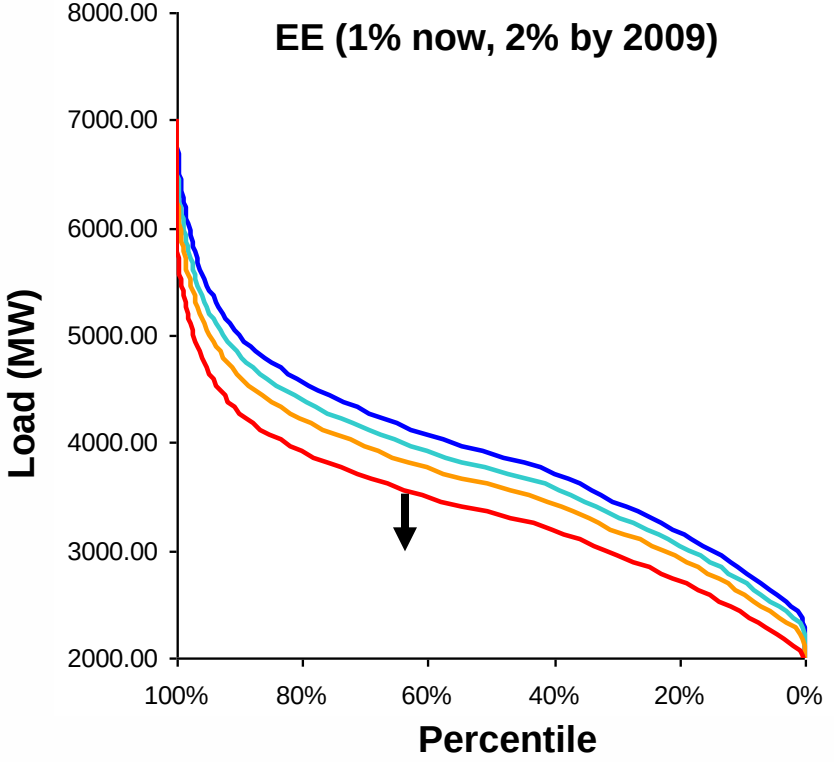
RMR Units

- RMRs run as intermediate units
- Spend significant time in spinning reserve, as well as peak response.



Results – Load Growth

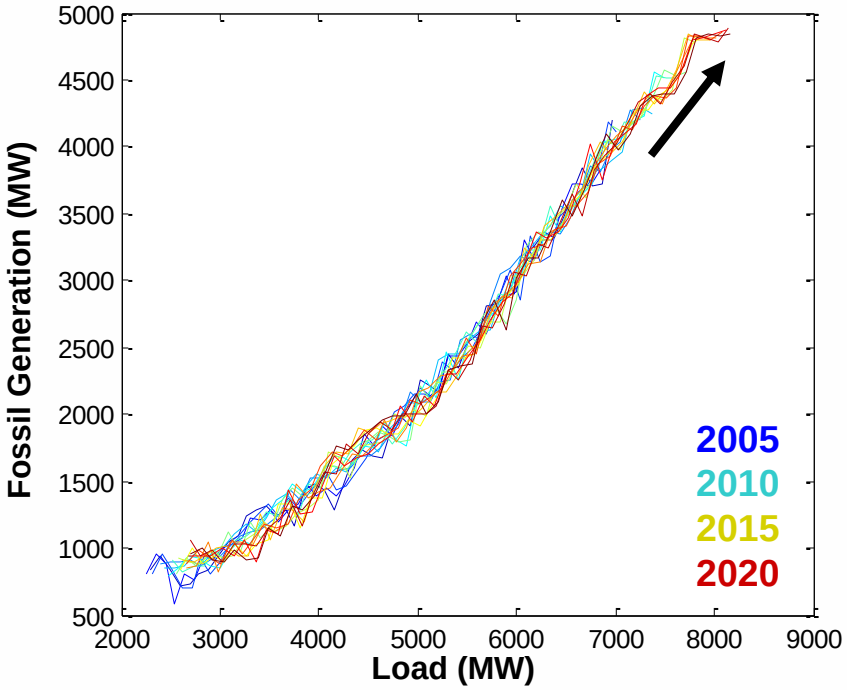




Load vs. Emissions Curves

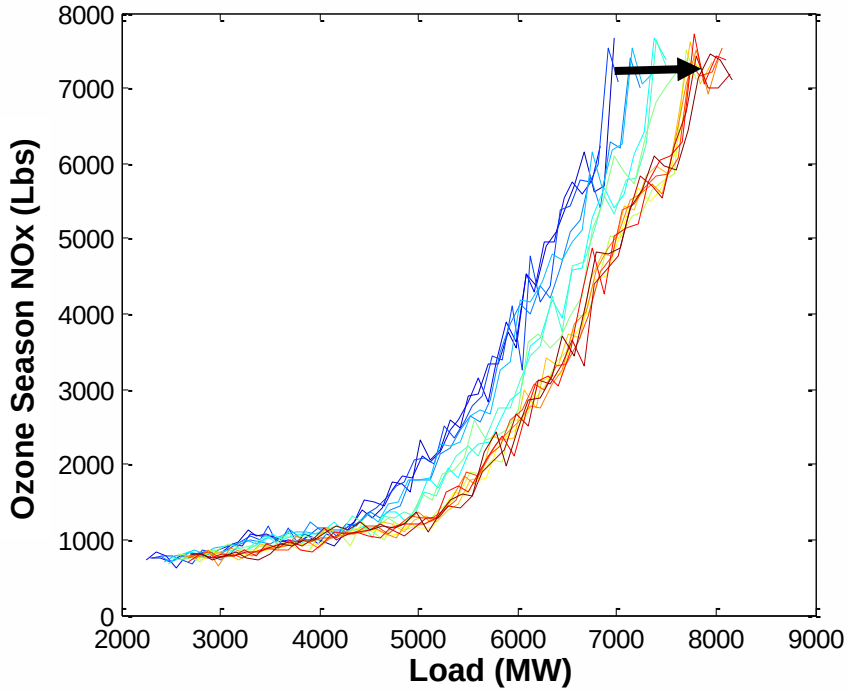
Baseline

Load vs. Generation



Growing demand increases generation requirements (assumed)

Load vs. NO_X Emissions

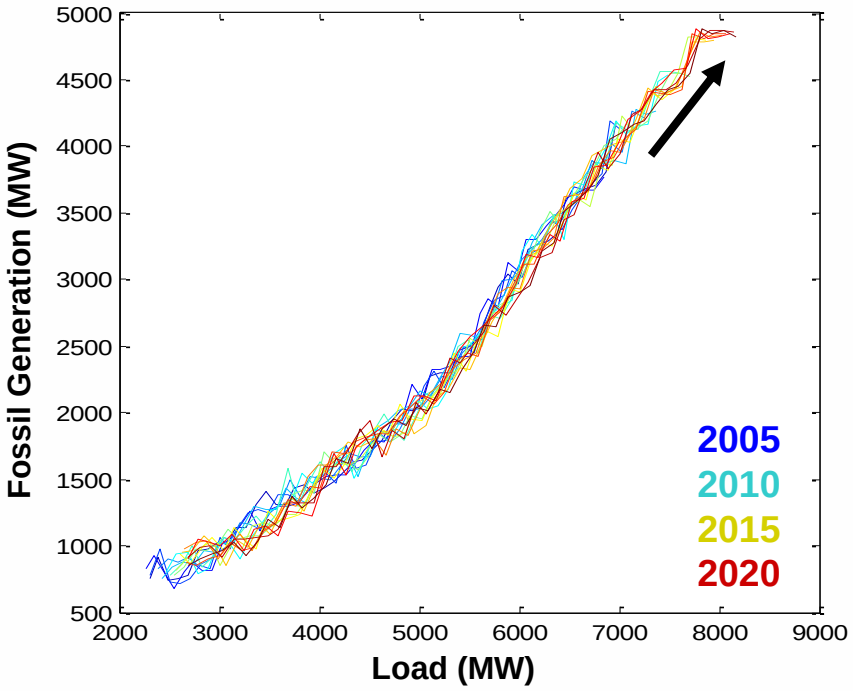


Growing demand does not substantially change emissions because new, clean units come online

Load vs. Emissions Curves

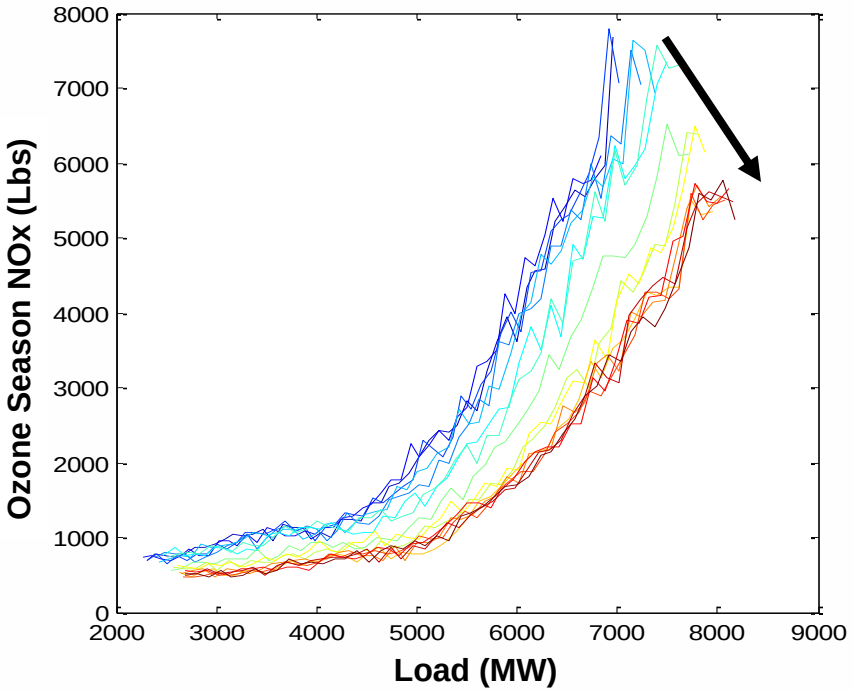
RMR units reduce emissions

Load vs. Generation



Unit operations are similar to baseline.

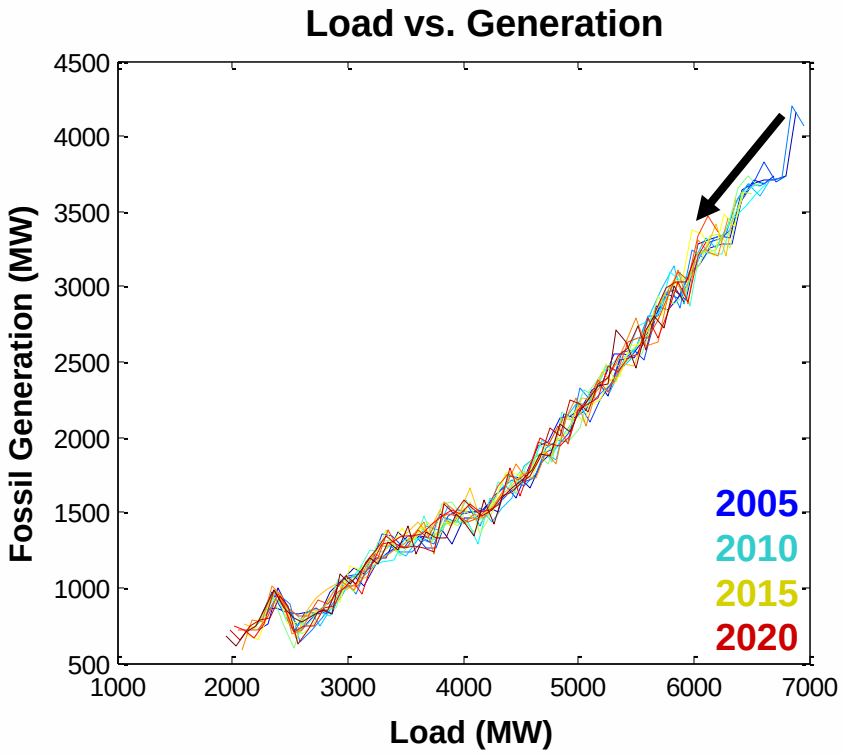
Load vs. NO_X Emissions



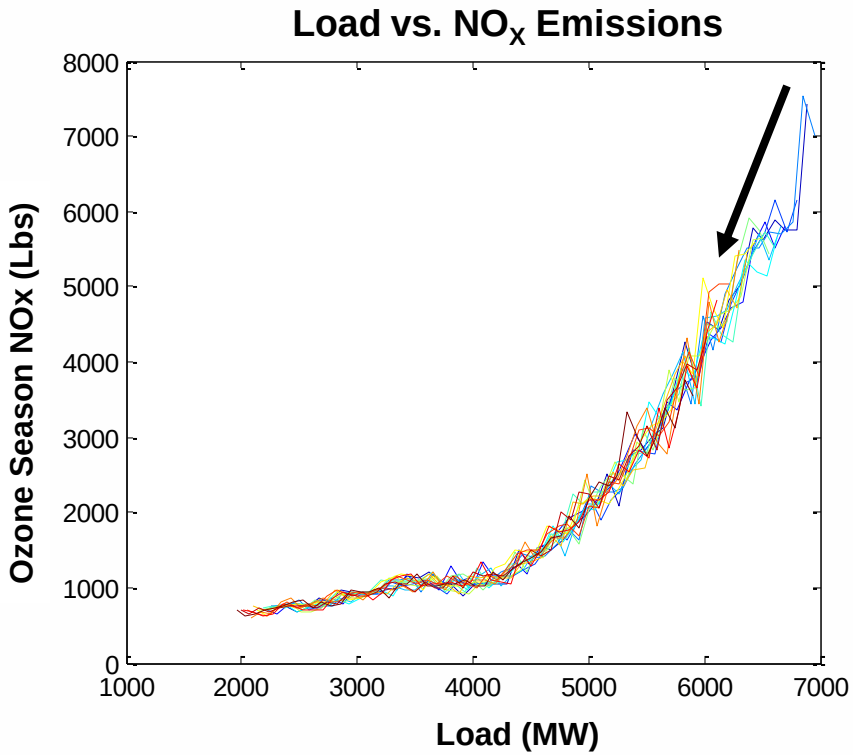
Steep emissions curve is function of RMR units. As emissions from these units are replaced, emissions drop steeply even as load grows.

Load vs. Emissions Curves

Energy efficiency (2% after 2009)



Energy efficiency reduces required generation.

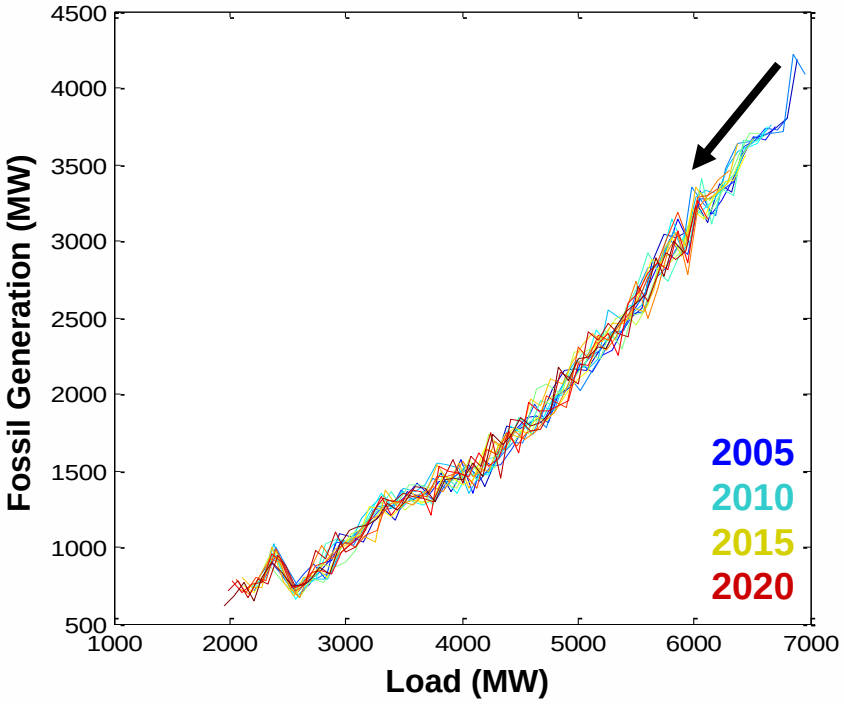


Because load vs. emissions curve is steep above ~4500 MW, EE reduces emissions in the top bracket.

Load vs. Emissions Curves

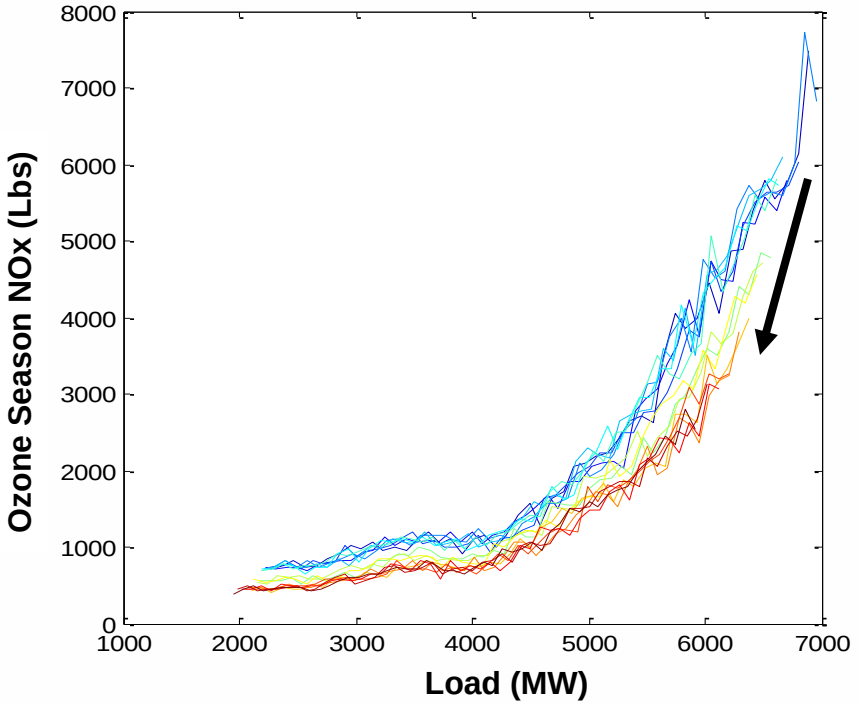
RMR units reduce and EE 2%

Load vs. Generation



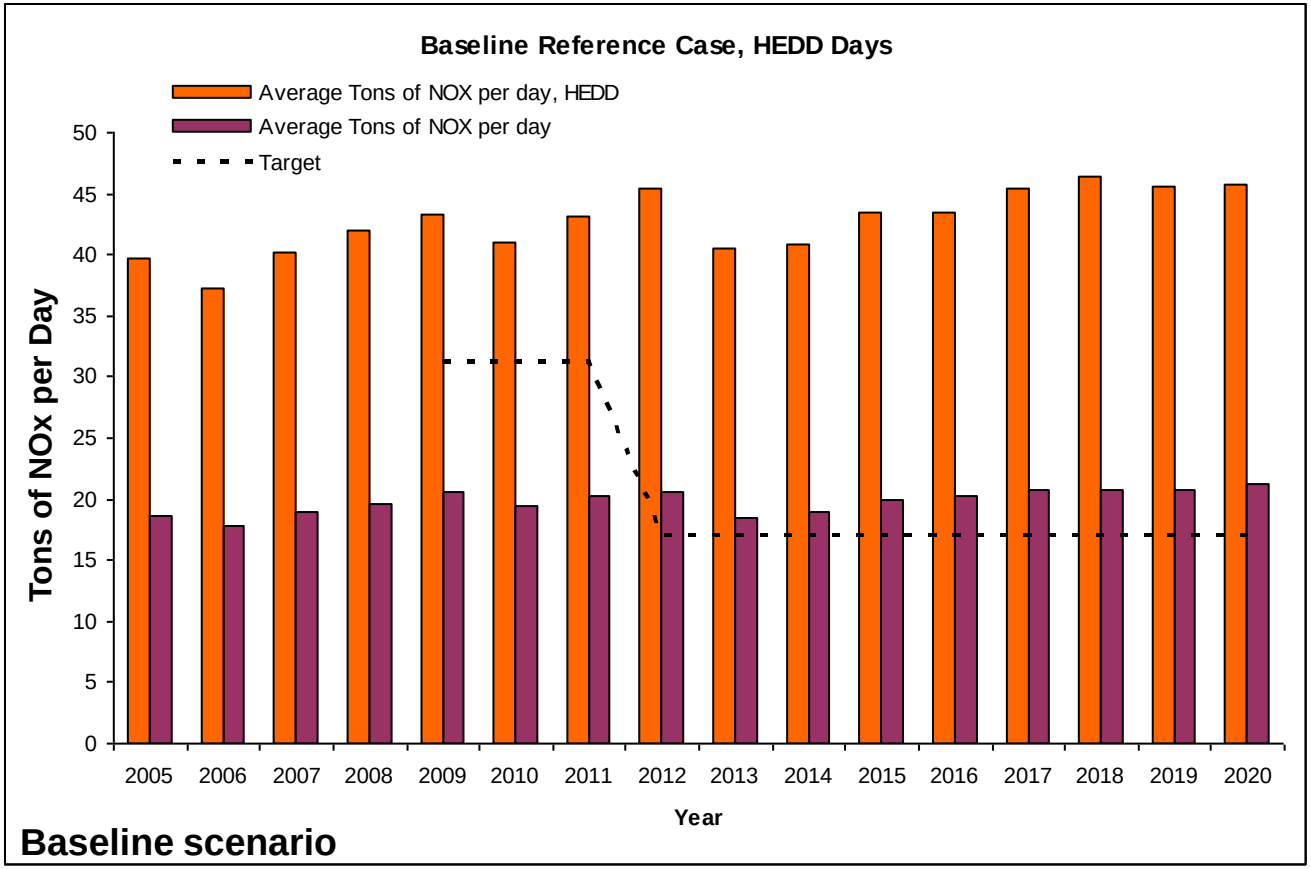
Energy efficiency reduces required generation.

Load vs. NO_X Emissions



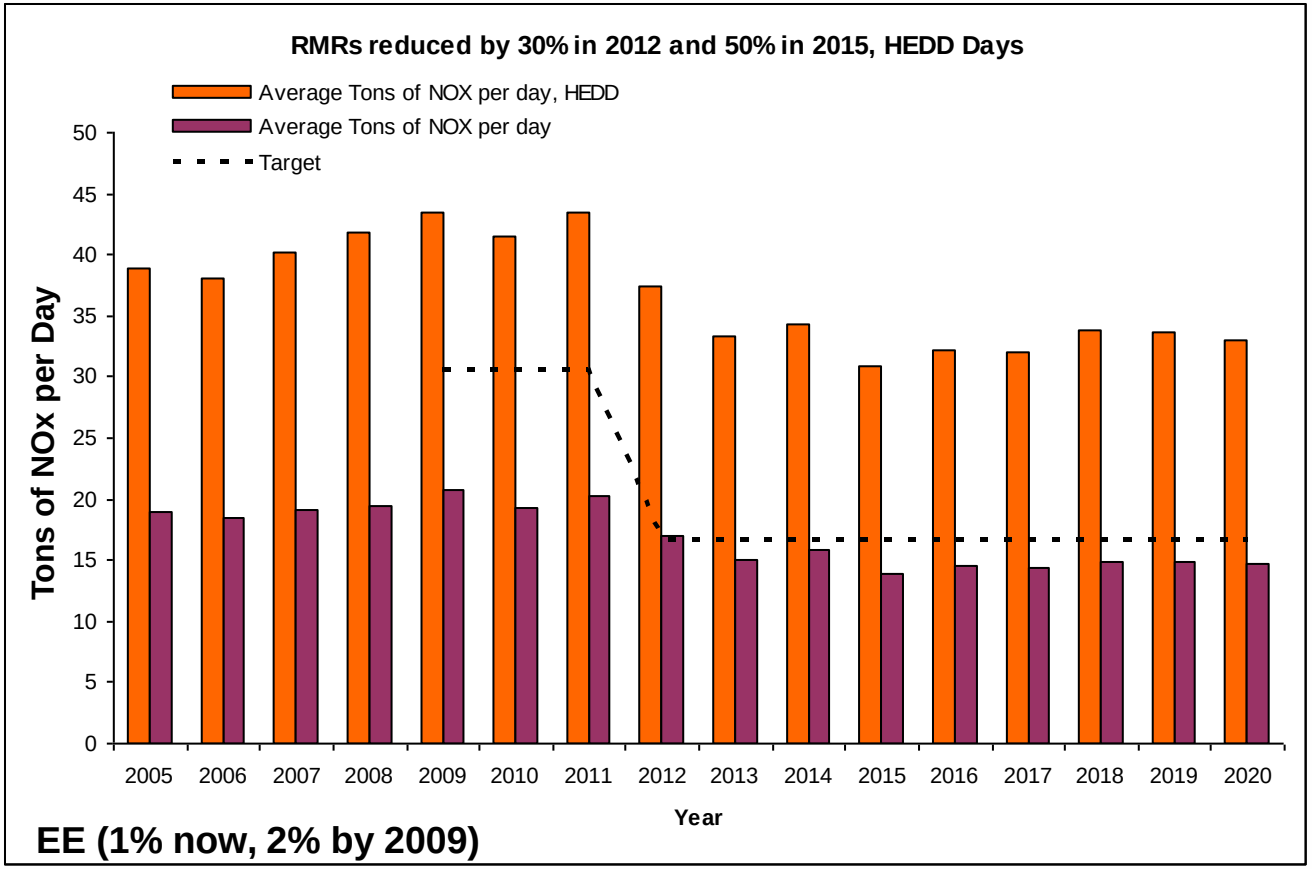
EE reduces emissions in the top bracket, and slope of NOx curve drops significantly.

HEDD and Ozone Season Emissions
Baseline scenario



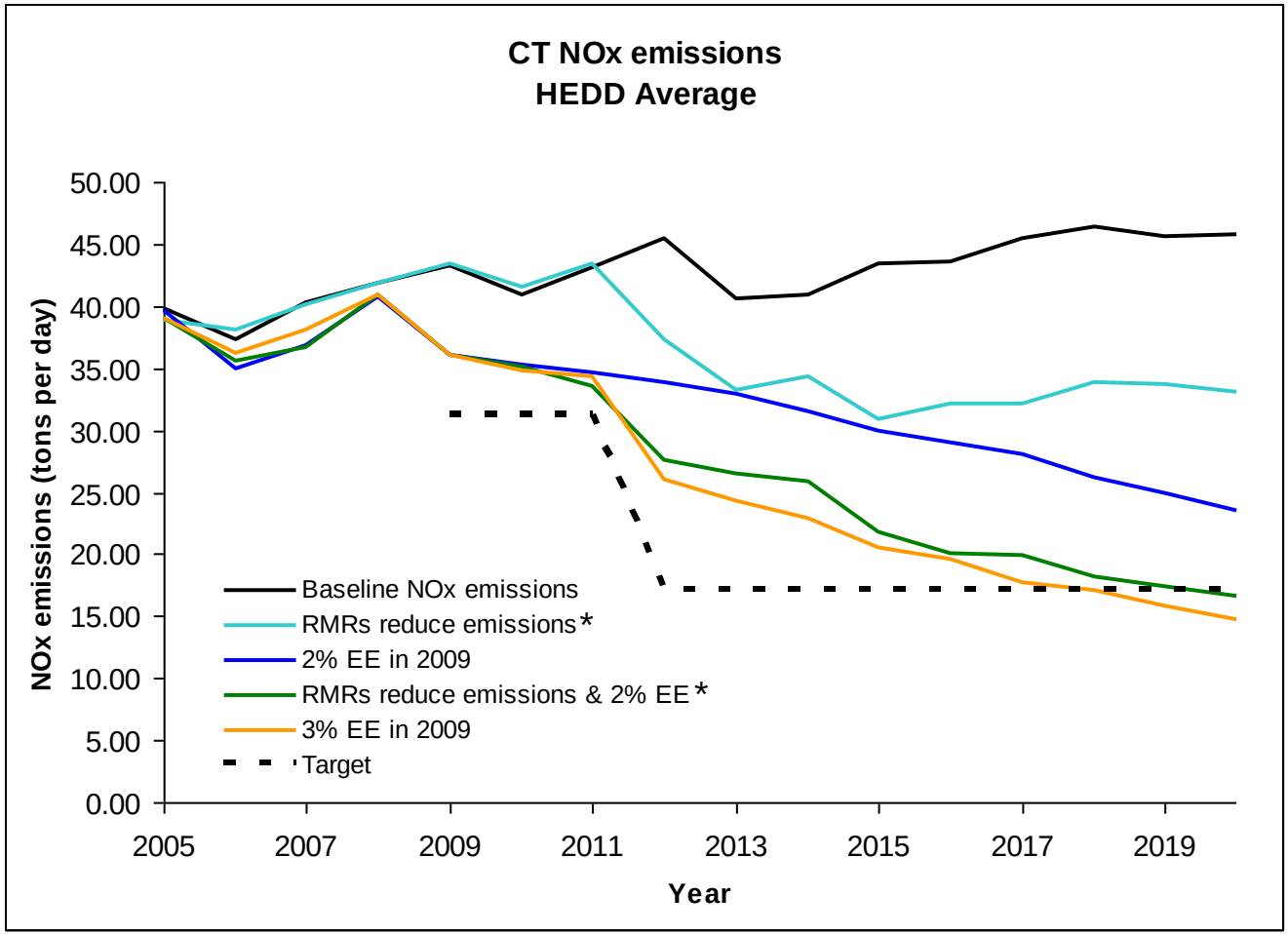
Target 22% below 2005 emissions in 2009; 57% below 2005 emissions in 2012

HEDD and Ozone Season Emissions Energy Efficiency (2%)



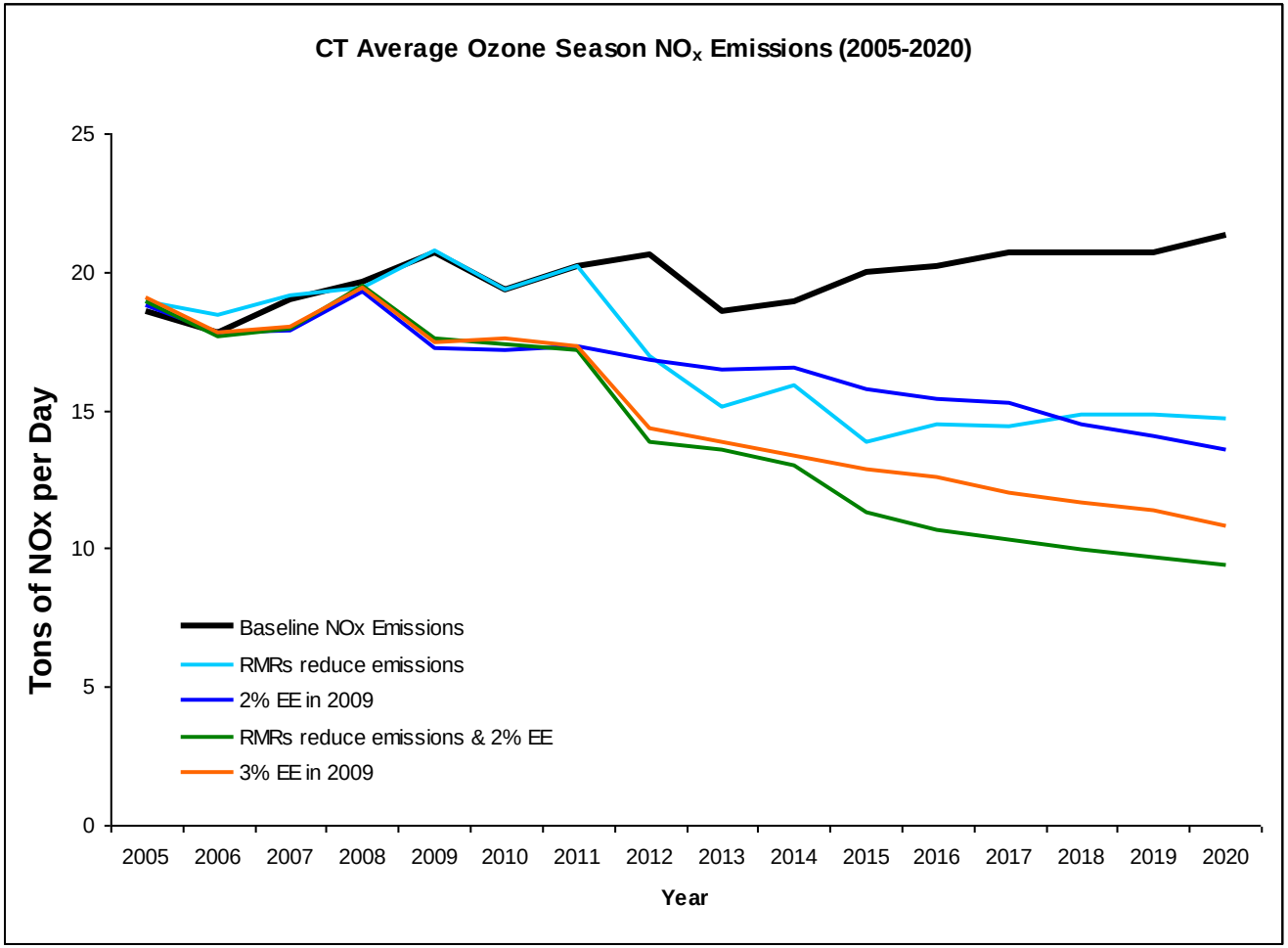
Target 22% below 2005 emissions in 2009; 57% below 2005 emissions in 2012

Multiple Scenarios: HEDD Emissions



**Scenario assumes RMRs reduce emissions by 30% in 2012 and 50% in 2015*

Multiple Scenarios: Ozone Season Emissions



EE Funding Assumptions

- Restoration of SBC to full 3 mil level (~$87 million/ year)
- RGGI auction allowances at $3 each
- FCM revenue at ~$4 million
- “White tag” revenue < $1 million
- Sustained commitment required to achieve Nox reductions

Recommendations

- Energy efficiency can help meet CT's Nox reduction needs. Requires sustained long-term commitment
- Additional Nox reductions needed to fill gap, provide certainty and to help meet new ozone standard
- Meeting 2009 targets is very difficult
- 2012 will require very aggressive EE plus SCR level of controls (min 50%)
- Sustained EE required to assure long-term compliance with ozone NAAQS

Role of Energy Efficiency

- ISO-NE FCM: EE = resource to others
- Capacity market: EE helping to reduce capacity prices. More EE expected
- Cost-effective: 3-4c/kWh v. >10c/kWh for new generation
- Avoids risk associated with fuel price volatility

Next Steps

- Synapse report submitted to CT DEP
- DEP expected to include as part of their SIP submittal to EPA
- Rulemaking to ensure Nox reductions are credible, certifiable, etc.

